



THE BEST IR SENSOR SYSTEM

BEST ROBOTICS 2019

INTRODUCTION

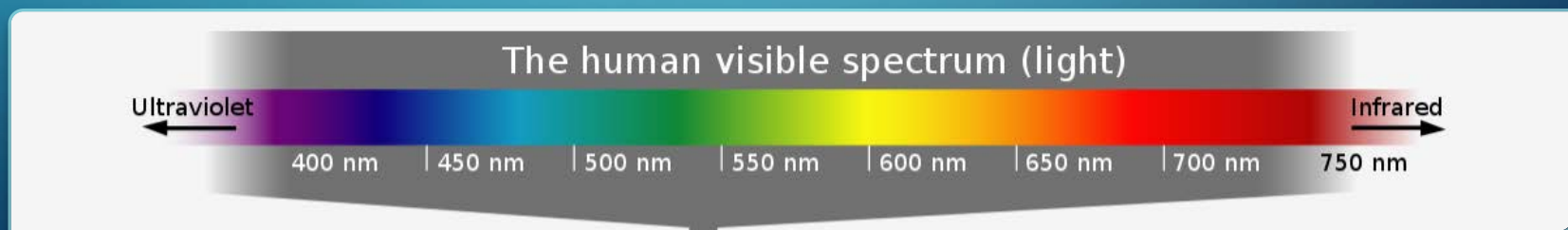
The BEST IR Sensor System will be valuable for the “Off the Grid” Challenge.

Click on the video below to see this year's challenge.



INFRARED LIGHT

The IR Sensor System uses Infrared radiation (IR), sometimes called infrared light. Infrared light is electromagnetic radiation with longer wavelengths than those of visible light. This makes it invisible to the human eye. One of the most useful applications of the IR spectrum is in sensing and detection.



The IR Sensor System consists mainly of a transmitter and a receiver. It uses infrared light as a type of wireless communication. The transmitter emits a continuous beam of infrared light...





... while the receiver senses the light and will change the output from high to low when it detects infrared light. By running the transmitter and the receiver output line continuously, a device can become a line tracker.



WHAT EFFECTS IT

The BEST IR system relies on sensing infrared rays. Different lighting factors, such as sunlight and fluorescent light can affect the transmitter.

Sunlight is itself a composition of a range of waves including the IR waves.

So the receiver treats it as a signal.

WHAT EFFECTS IT

Adding special receiver lenses can be added to block out the sunlight or any other type of light that causes interference.



Inside a building, fluorescent lighting can adversely affect a transmitter. Fluorescent lights flash on and off 120 times each second. Our eyes don't notice this action, but a fast-electronic detector will easily notice the flicker.

Your team will need to consider how to adapt to the environment in which your IR System will be working.

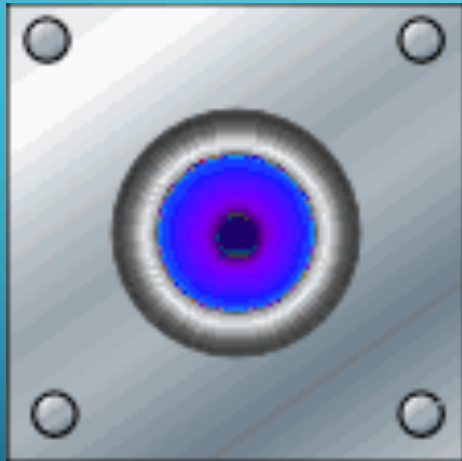




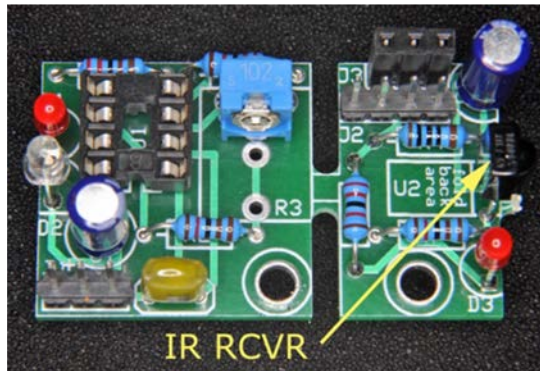
DISCUSSION

HOW DO YOU THINK TEAMS CAN RESOLVES THESE PROBLEMS
WHEN USING THE BEST IR SENSOR SYSTEM?

HOW BEST ROBOTICS APPROACHES THE PROBLEM

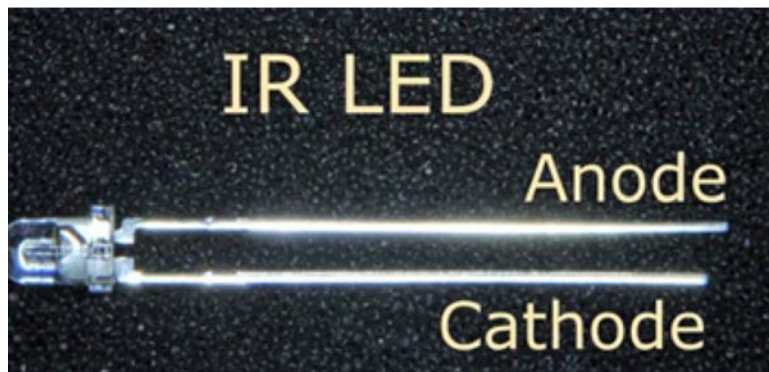
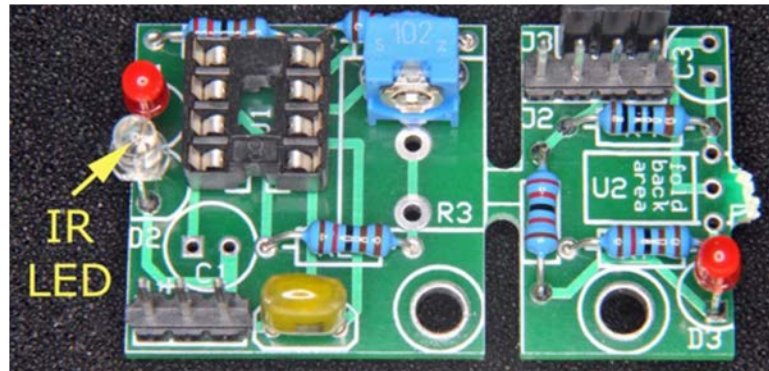


The BEST IR system uses two techniques to minimize interference from our man-made light sources – the frequency of light used (its “color”) and the rate in which it is turning our light on and off (“modulation”).



COLOR

Look at the IR detector. It looks almost black. Just as we can make plastic that lets red light thru but blocks blue or green light, we can make plastic that lets infrared light thru but blocks all the visible light colors. Such a plastic is used on the IR detector package. To us, it looks black because no visible light can get thru. It is transparent to IR light which passes easily to the detector chip.

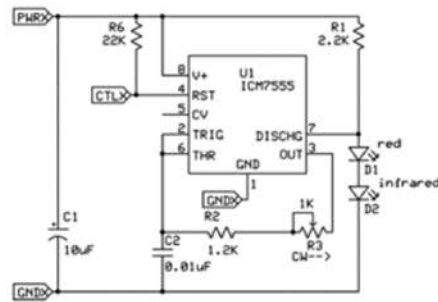
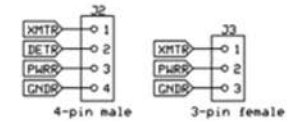
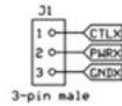


MODULATION

The IR detector is also equipped to handle the modulation factor as well. Instead of merely producing IR light that is always on, we can modulate it by rapidly turning it on and off. In fact, our IR detector chip is designed with this in mind.

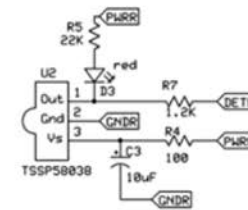
The IR transmitter emits infrared light modulated at a specific frequency. The transmitter used in this project will modulate the IR signals at nearly 38 KHz. The receiver will be looking for light that turns off and on 38,000 times per second and ignores any light that does not.

A SCHEMATIC DEMONSTRATES HOW THE BEST ROBOTICS IR SYSTEM WORKS.



IR Transmitter

D1 emits IR modulated at 38KHZ (nominal).
 Modulation frequency can be tuned by R3.



IR Receiver

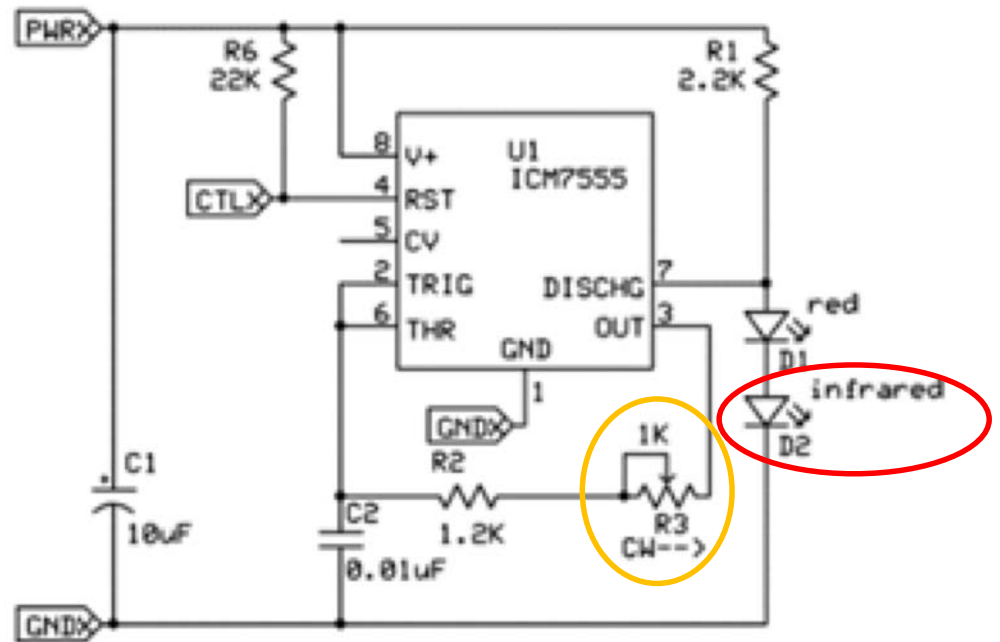
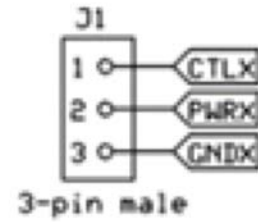
DETRD goes low when 38KHZ modulated IR is detected.

BEST Robotics, Inc.		
IR Transmitter & Receiver		
Steve Marum	Rev 0.3 3/8/2016	Schematic

THE IR TRANSMITTER

D2 emits an IR modulated light at 38KHZ. The modulation frequency can be tuned by R3.

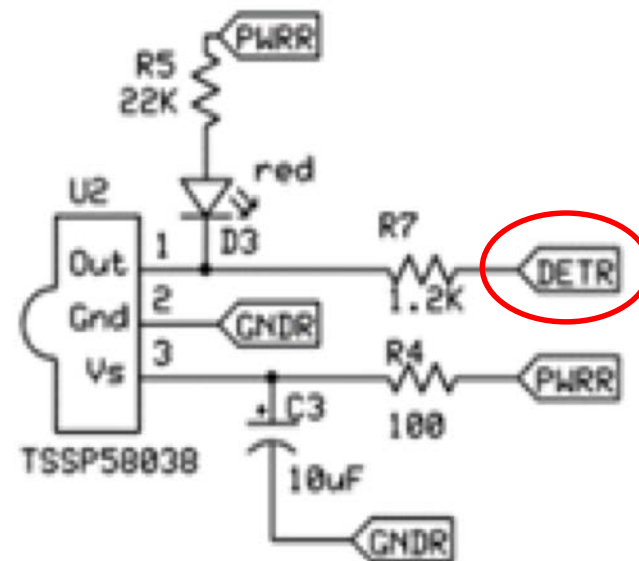
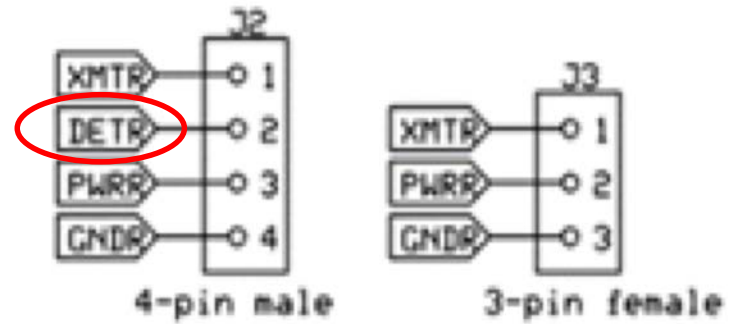
Can someone point out these components?



THE IR TRANSMITTER

DETR goes low when 38KHZ modulated IR is detected.

Can someone point out these components?



COMPETITION CONNECTION

These circuits are versatile building blocks which can be used to do any of these things:

Beam Blocker: Run the transmitter continuously and use the receiver to detect when something blocks the light.

Line Follower: Run the transmitter continuously and use the receiver to detect the light reflected from a line under the robot

(Advanced) Simple Signaling: Communicate with another robot or the field by sending and receiving pulses of various widths, or different numbers of pulses.



DISCUSSION

WHAT ARE SOME WAYS YOU WOULD LIKE TO TRY USING THE
IR SYSTEM?

BESTOLOGY

For more STEM connection check out bESTology.

bESTology is a resource for schools (teams) participating in the nationwide BEST Robotics Program to learn educational and workforce development concepts revolving around the 2019 game.



ANNOTATIONS

Slide 2: <https://youtu.be/kcaoyXWEDCU>

Slide 3: https://commons.wikimedia.org/wiki/File:Electromagnetic_spectrum_-eng.svg

Slide 4: <https://pixabay.com/photos/lighthouse-night-light-military-2839951/>

<https://pixabay.com/illustrations/board-conductors-circuits-2965056/>

Slide 5: https://upload.wikimedia.org/wikipedia/commons/8/88/Dragon_Runner_Bomb_Disposal_Robot_MOD_45159060.jpg

Slide 6: <https://pixabay.com/photos/sunrise-sun-clouds-sky-mood-3533173/>

Slide 7: <https://pixabay.com/photos/lens-telephoto-lens-photograph-3088589/>

Slide 8: <https://pixabay.com/photos/school-lockers-hallway-high-school-417612/>

Slide 9: <https://pixabay.com/illustrations/banner-header-question-mark-1090830/>

Slide 10: https://upload.wikimedia.org/wikipedia/commons/b/bf/Blue_flashing_light.gif

Slide 17: <https://pixabay.com/illustrations/banner-header-question-mark-1090830/>

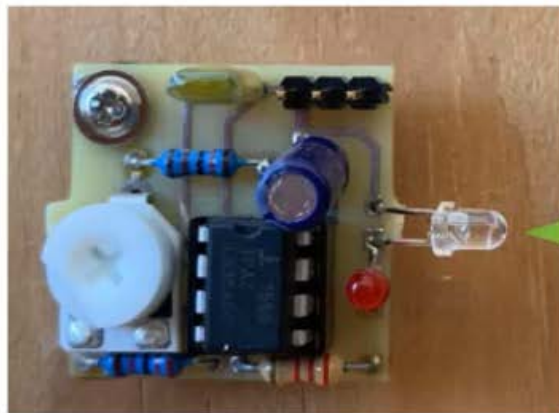
IR SENSOR NOTES ON ASSEMBLY

- Be careful when soldering not to damage the parts.
- Be careful to get the parts that have polarity in the correct way.
- Do not solder the socket for the 7555 timer with the timer in the socket (this can damage the timer chip)

MATHWORKS TRAINING VIDEO

- <https://www.youtube.com/watch?v=x4iBxsRjGYs&t=>

BASIC FUNCTION



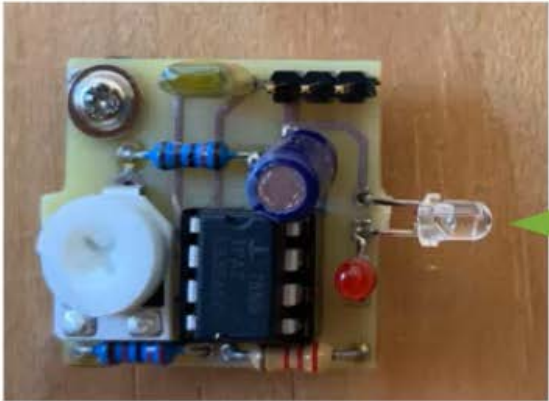
Transmitter

Beam
Projection Area



Receiver

BASIC FUNCTION



Transmitter

Beam
Projection Area



Receiver
Field
Of
View

Receiver

SIMPLE IR SENSOR TESTING

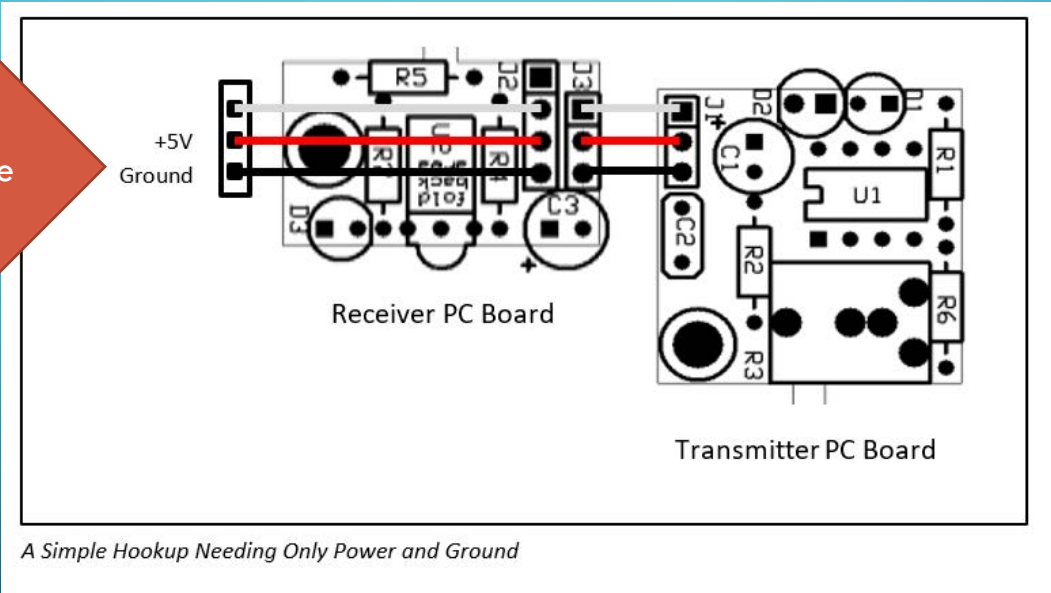
- Beam break testing is the most basic form of test for the sensor
- Line follower is also easy to test

SIMPLE IR SENSOR TEST WIRING



SIMPLE IR SENSOR TEST WIRING

Be careful to make sure the +5V and Ground are in the correct places

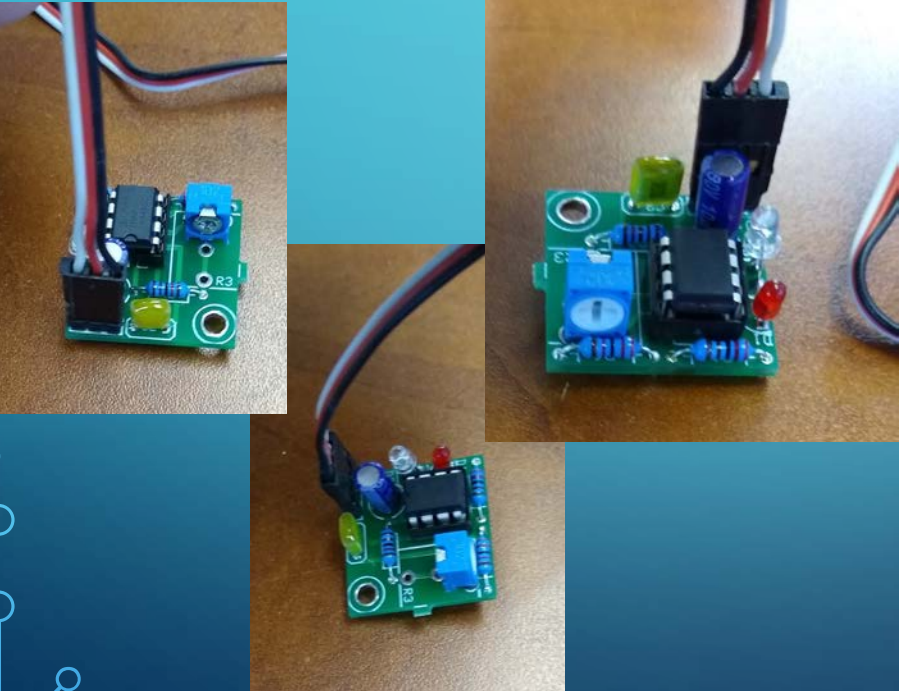


SIMPLE IR SENSOR TEST WIRING

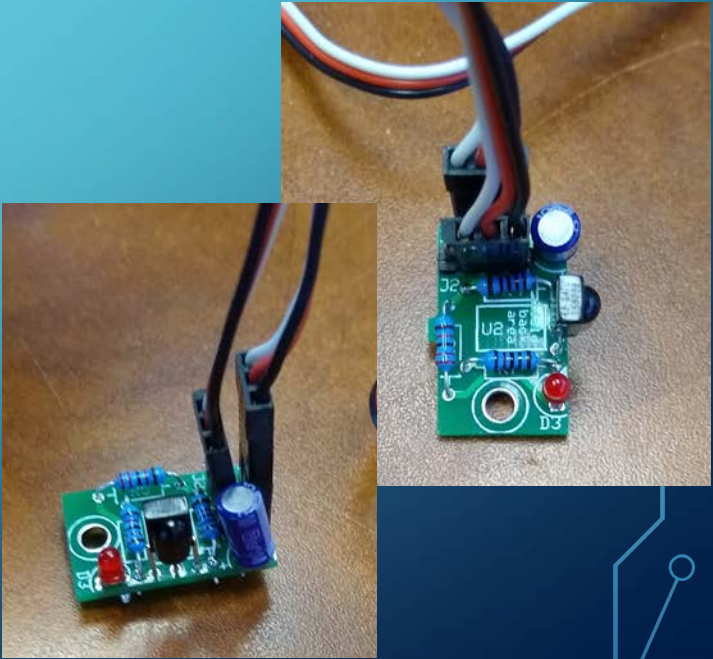


SIMPLE IR SENSOR TEST WIRING

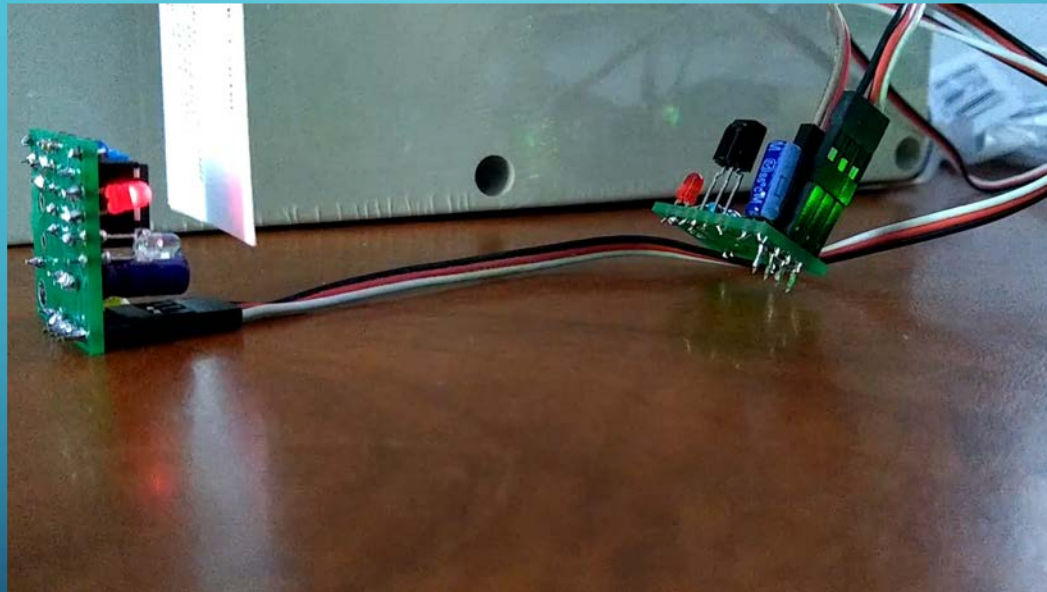
Transmitter Wiring



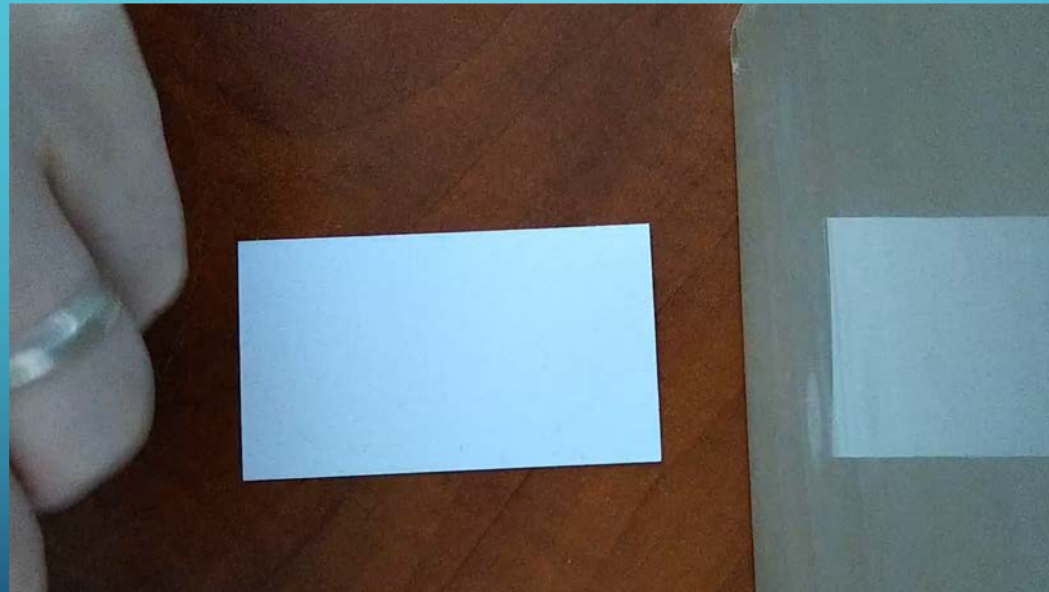
Receiver Wiring



BEAM BREAK TESTING

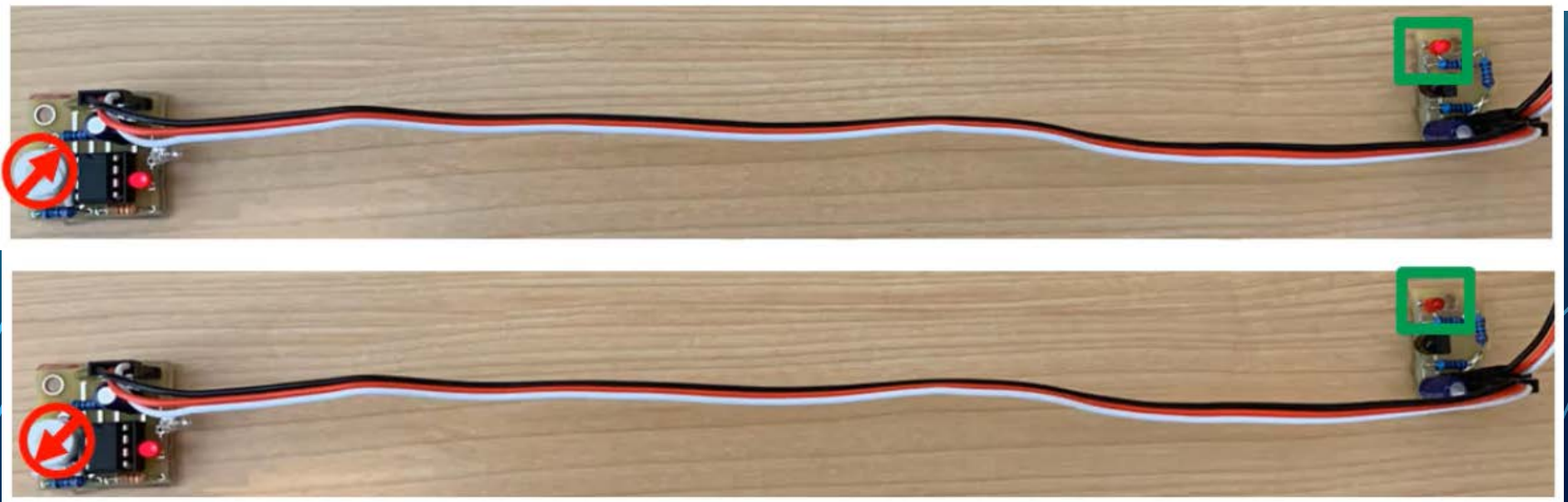
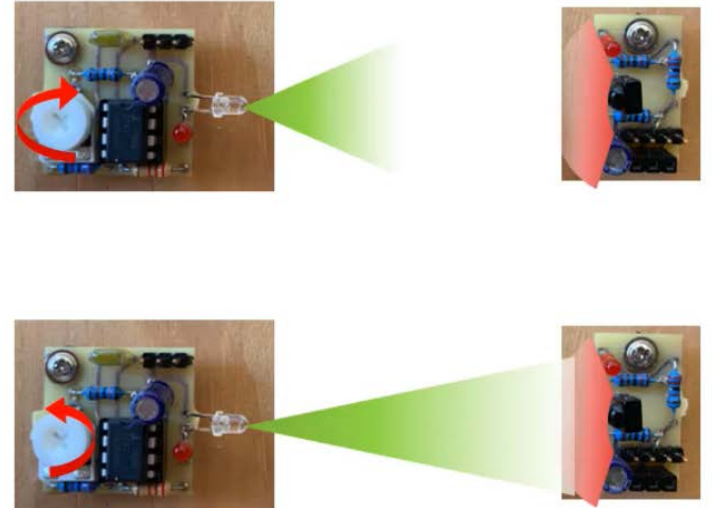


LINE FOLLOWER TESTING

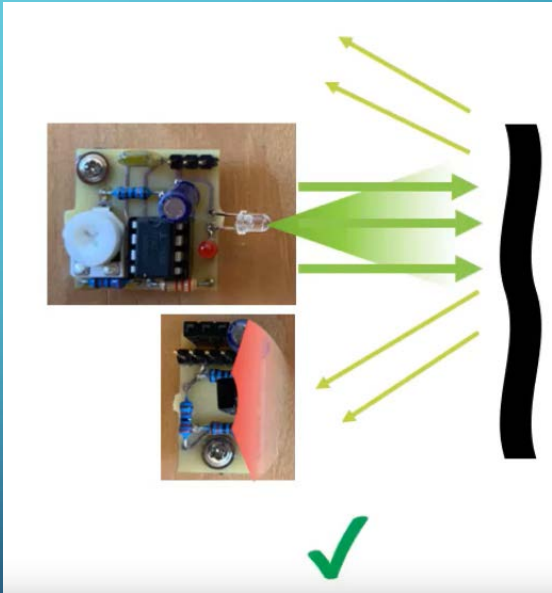
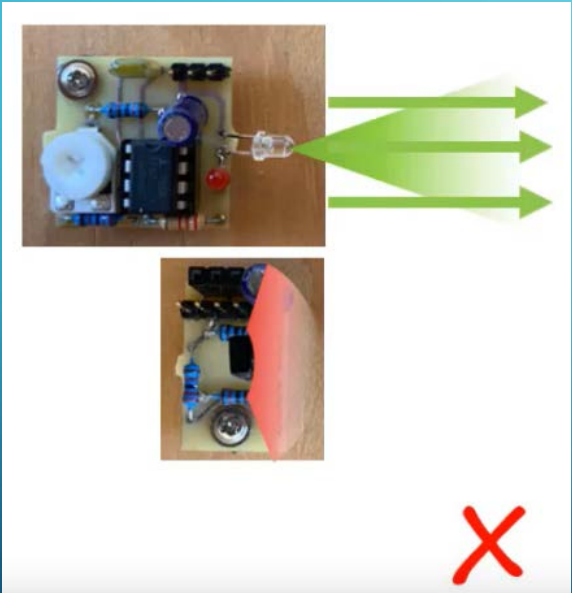


SENSITIVITY

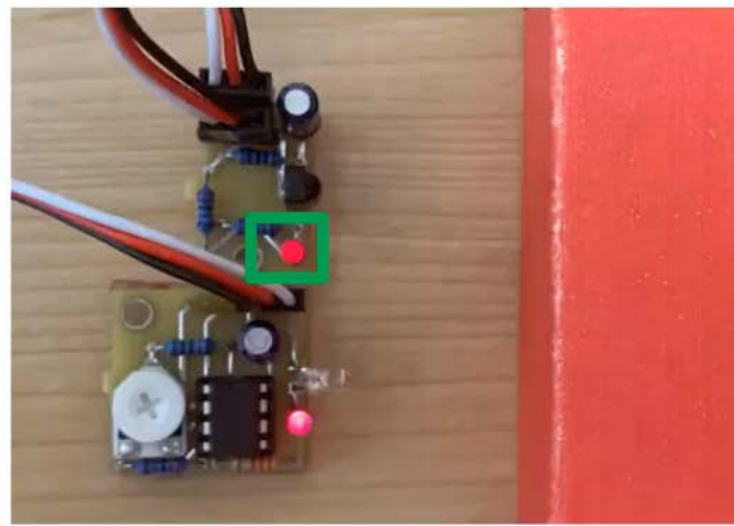
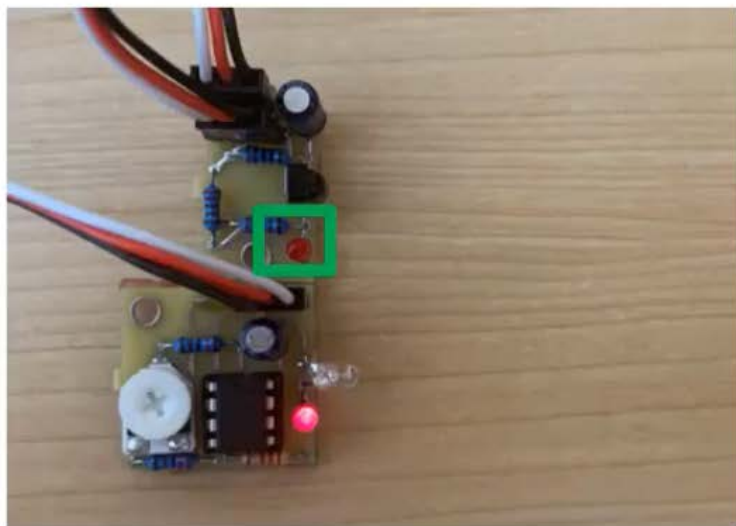
- Adjust potentiometer to change sensitivity
- Somewhere in the middle (not either extreme) is the highest sensitivity



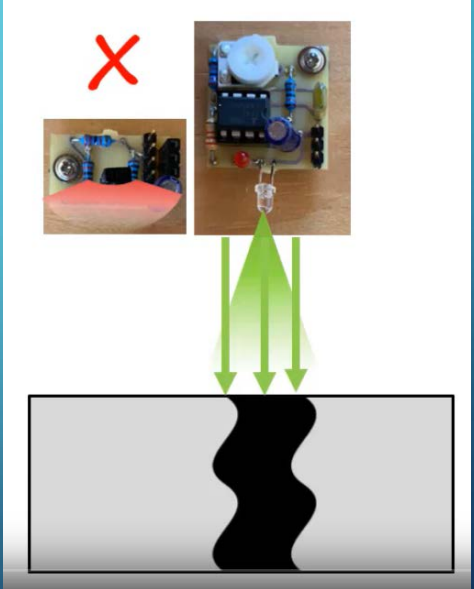
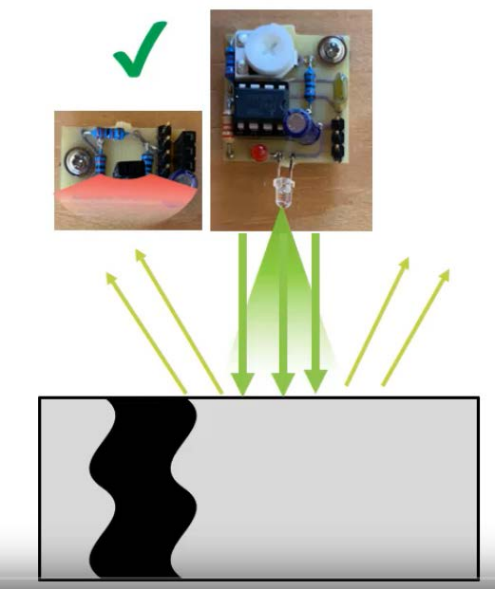
OBJECT DETECTION



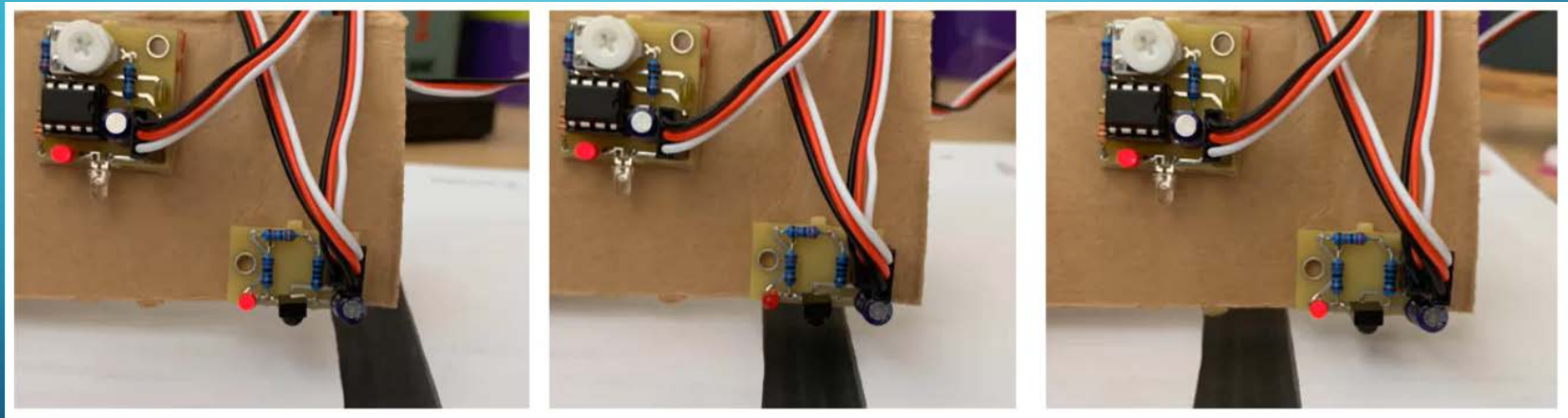
OBJECT DETECTION



LINE DETECTION

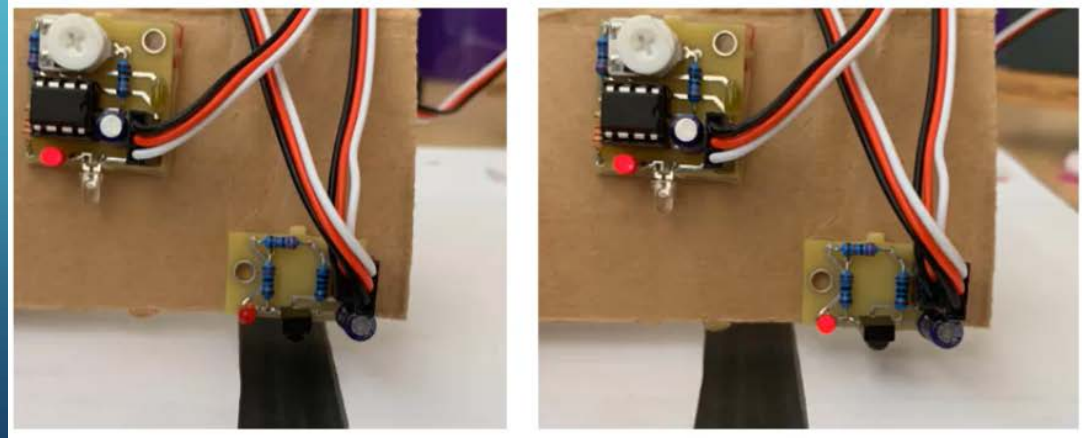
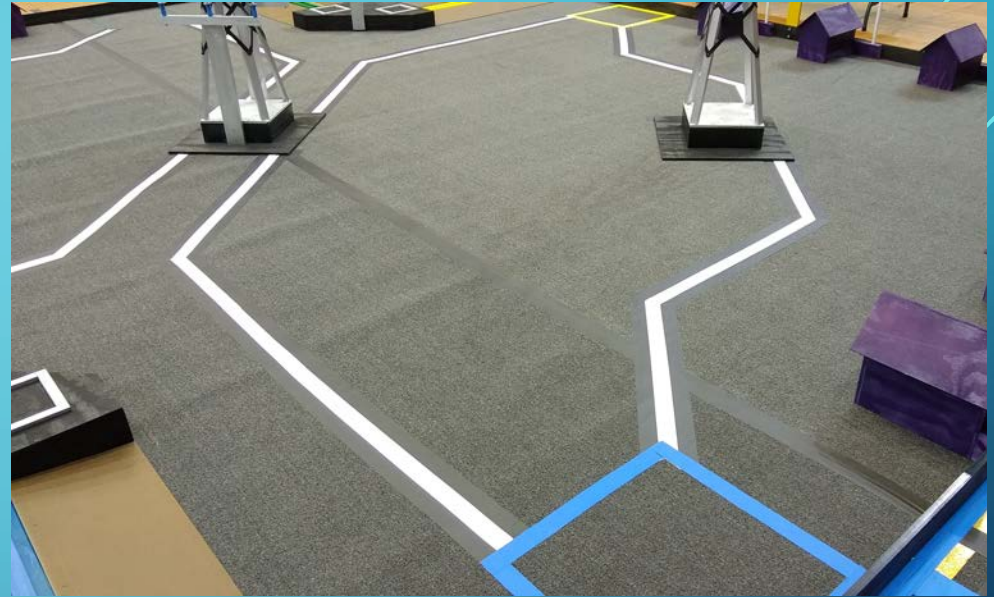


LINE DETECTION



LINE DETECTION

- How many of you noticed the lines taped on the field?
- What color/color pattern were they?
- How can you use them?
- What will your LED on the receiver look like?





FINAL QUESTIONS?